

WHAT IS CLAIMED IS:

1. A semiconductor optical device comprising:

a first conductivity type semiconductor region, provided on a surface of GaAs semiconductor, having first and second semiconductor portions, said first semiconductor portion having a primary surface, said primary surface having a first area and a second area, said first area being provided between said second area, said second semiconductor portion having a pair of side surfaces, 10 said second semiconductor portion being provided on the first area of said first semiconductor portion;

an active layer, provided on said second semiconductor portion of said first conductivity type semiconductor region, having a pair of side surfaces;

15 a second conductivity type semiconductor layer, provided on said active layer, having a pair of side surfaces; and

20 a current block semiconductor region for confining carriers to said second semiconductor portion, said active layer, and said second conductivity type semiconductor layer;

25 wherein the current block semiconductor region is provided on the second area of the first semiconductor portion of the first conductivity type semiconductor region, said surfaces of said second semiconductor portion, said side surfaces of said active layer, and said side surfaces

of said second conductivity type semiconductor layer;

wherein said active layer is made of III-V compound semiconductor including at least nitrogen (N) as a V group member; and

5 wherein said active layer is provided so as to generate light having a wavelength of 0.9 micrometers or longer.

2. The semiconductor optical device according to claim 1, wherein said active layer is made of III-V compound 10 semiconductor including gallium (Ga) as a III group member, and

wherein said III-V compound semiconductor of said active layer includes at least arsenic (As) as a V group member.

15 3. The semiconductor optical device according to claim 1, wherein said active layer is made of at least one of GaInNAs semiconductor, GaNAs semiconductor, GaNAsSb semiconductor, GaNAsP semiconductor, GaNAsSbP semiconductor, GaInNAsSb semiconductor, GaInNAsP semiconductor and GaInNAsSbP semiconductor.

20 4. The semiconductor optical device according to claim 1, wherein a refractive index of said second conductivity type semiconductor layer is higher than that of said current block semiconductor region.

25 5. The semiconductor optical device according to claim 1, further comprising an additional semiconductor

layer containing III-V compound semiconductor;

wherein said additional semiconductor layer is provided between said first conductivity type semiconductor region and said active layer; and

5 wherein a photoluminescence wavelength of said III-V compound semiconductor is between that of said active layer and that of said first conductivity type semiconductor region.

6. The semiconductor optical device according to
10 claim 1, further comprising an additional semiconductor layer containing III-V compound semiconductor;

wherein said additional semiconductor layer is provided between said second conductivity type semiconductor layer and said active layer; and

15 wherein a photoluminescence wavelength of said III-V compound semiconductor is between that of said active layer and that of said second conductivity type semiconductor layer.

7. The semiconductor optical device according to
20 claim 1, further comprising a first SCH layer provided between said first conductivity type semiconductor region and said active layer; and

a second SCH layer provided between said active layer and said second conductivity type semiconductor layer.

25 8. The semiconductor optical device according to
claim 7, further comprising an additional semiconductor

layer containing III-V compound semiconductor;

wherein said additional semiconductor layer is provided between said first conductivity type semiconductor region and said first SCH layer; and

5 wherein a photoluminescence wavelength of said III-V compound semiconductor is between that of said first SCH layer and that of said first conductivity type semiconductor layer.

9. The semiconductor optical device according to
10 claim 7, further comprising an additional semiconductor layer containing III-V compound semiconductor;

wherein said additional semiconductor layer is provided between said second conductivity type semiconductor layer and said second SCH layer;

15 wherein a photoluminescence wavelength of said III-V compound semiconductor is between that of said second SCH layer and that of said second conductivity type semiconductor layer.

10. The semiconductor optical device according to
20 claim 1, wherein said current block semiconductor region comprises first and second current block layers;

wherein said first conductivity type semiconductor region is made of $(Al_{x_1}Ga_{1-x_1})_{y_1}In_{1-y_1}P$ semiconductor, where a composition X_1 has a value within the range of zero or
25 greater but not greater than 1;

wherein said second conductivity type semiconductor

layer is made of $(Al_{x_2}Ga_{1-x_2})_{y_2}In_{1-y_2}P$ semiconductor, where a composition X_2 has a value within the range of zero or greater but not greater than 1; and

5 wherein said first and second current block layers are made of $(Al_{x_3}Ga_{1-x_3})_{y_3}In_{1-y_3}P$ semiconductor, where a composition X_3 has a value within the range of zero or greater but not greater than 1.

10 11. The semiconductor optical device according to claim 1, wherein said current block semiconductor region comprises first and second current block layers;

wherein said first conductivity type semiconductor region is made of an $Al_{x_1}Ga_{1-x_1}As$ semiconductor, where a composition X_1 has a value within the range of zero or greater but not greater than 1;

15 wherein said second conductivity type semiconductor layer is made of an $Al_{x_2}Ga_{1-x_2}As$ semiconductor, where a composition X_2 has a value within the range of zero or greater but not greater than 1; and

20 wherein said first and second current block layers are made of $Al_{x_3}Ga_{1-x_3}As$ semiconductor, where a composition X_3 has a value within the range of zero or greater but not greater than 1.

12. The semiconductor optical device according to claim 7,

25 wherein said first and second SCH layers are made of one of $Al_xGa_{1-x}As$ semiconductor ($0 \leq x \leq 1$) and $Ga_xIn_{1-x}As_yP_{1-y}$

semiconductor (about $0.5 \leq x \leq 1$, $0 \leq y \leq 1$), said $Ga_xIn_{1-x}As_yP_{1-y}$ semiconductor lattice-matched to GaAs semiconductor.

13. The semiconductor optical device according to
5 claim 1, wherein said current block semiconductor region
comprises first and second current block layers; and

wherein said first and second current block
semiconductor layers are made of material not containing
aluminum as a III group element.

10 14. The semiconductor optical device according to
claim 1, wherein said current block semiconductor region
comprises first and second current block layers; and

wherein said first and second current block
semiconductor layers are made of material not containing
15 aluminum as a III group element,

wherein said first conductivity type semiconductor
region is made of material not containing aluminum as a III
group element, and

20 wherein said second conductivity type semiconductor
layer is made of material not containing aluminum as a III
group element.

15. The semiconductor optical device according to
claim 1, wherein said surface of GaAs semiconductor is
provided by one of a GaAs semiconductor layer and a gallium
25 arsenide substrate.

16. The semiconductor optical device according to

claim 1, wherein said semiconductor optical device is constituted to provide at least one of a semiconductor laser diode, a semiconductor optical amplifier, and an electro-absorption modulator.

5 17. A semiconductor optical device comprising:

a first conductivity type semiconductor region, provided on a surface of GaAs semiconductor, including a primary surface having a first area and a second area, said first area being provided between said second areas;

10 a semiconductor ridge including an active layer provided on said first area of said first conductivity type semiconductor region and a second conductivity type semiconductor layer provided on said active layer, said semiconductor ridge having a pair of side surfaces; and

15 a current block semiconductor region provided on said second area of said first conductivity type semiconductor region and said side surfaces of said semiconductor ridge, said current block semiconductor region being provided for confining carriers to said semiconductor ridge;

20 wherein said active layer is made of III-V compound semiconductor including at least nitrogen (N) as a V group member; and

wherein said active layer is provided to generate light having a wavelength of 0.9 micrometers or longer.

25 18. The semiconductor optical device according to claim 17, wherein said first conductivity type

5 semiconductor region is made of semiconductor material enabling said first conductivity type semiconductor region to be a etch stopper resistant to etchant for etching said active layer and said second conductivity type semiconductor layer.

19. The semiconductor optical device according to claim 17, wherein said active layer is made of III-V compound semiconductor including gallium (Ga) as a III group member, and

10 wherein said III-V compound semiconductor of said active layer includes at least arsenic (As) as a V group member.

15 20. The semiconductor optical device according to claim 17, wherein said active layer is made of at least one of GaInNAs semiconductor, GaNAs semiconductor, GaNAsSb semiconductor, GaNAsP semiconductor, GaNAsSbP semiconductor, GaInNAsSb semiconductor, GaInNAsP semiconductor and GaInNAsSbP semiconductor.

20 21. The semiconductor optical device according to claim 17, wherein said second conductivity type semiconductor layer has a refractive index higher than that of said current block semiconductor region.

25 22. The semiconductor optical device according to claim 17, further comprising an additional semiconductor layer containing III-V compound semiconductor;

 wherein said additional semiconductor layer is

provided between said first conductivity type semiconductor region and said active layer; and

wherein a photoluminescence wavelength of said III-V compound semiconductor is between that of said active layer and that of said first conductivity type semiconductor region.

23. The semiconductor optical device according to claim 17, further comprising an additional semiconductor layer containing III-V compound semiconductor;

10 wherein said additional semiconductor layer is provided between said second conductivity type semiconductor layer and said active layer; and

wherein a photoluminescence wavelength of said III-V compound semiconductor is between that of said active layer and that of said second conductivity type semiconductor layer.

24. The semiconductor optical device according to claim 17, further comprising a first SCH layer provided between said first conductivity type semiconductor region and said active layer; and

a second SCH layer provided between said active layer and said second conductivity type semiconductor layer.

25. The semiconductor optical device according to claim 24, further comprising an additional semiconductor layer containing III-V compound semiconductor;

wherein said additional semiconductor layer is

provided between said first conductivity type semiconductor region and said first SCH layer; and

5 wherein a photoluminescence wavelength of said III-V compound semiconductor is between that of said first SCH layer and that of said first conductivity type semiconductor layer.

26. The semiconductor optical device according to claim 24, further comprising an additional semiconductor layer containing III-V compound semiconductor;

10 wherein said additional semiconductor layer is provided between said second conductivity type semiconductor layer and said second SCH layer;

15 wherein a photoluminescence wavelength of said III-V compound semiconductor is between that of said second SCH layer and that of said second conductivity type semiconductor layer.

27. The semiconductor optical device according to claim 17, wherein said current block semiconductor region comprises first and second current block layers;

20 wherein said first conductivity type semiconductor region is made of $(Al_{x_1}Ga_{1-x_1})_{y_1}In_{1-y_1}P$ semiconductor, where a composition X_1 has a value within the range of zero or greater but not greater than 1;

25 wherein said second conductivity type semiconductor layer is made of $(Al_{x_2}Ga_{1-x_2})_{y_2}In_{1-y_2}P$ semiconductor, where a composition X_2 has a value within the range of zero or

greater but not greater than 1; and

wherein said first and second current block layers are made of $(Al_{x_3}Ga_{1-x_3})_{y_3}In_{1-y_3}P$ semiconductor, where a composition X_3 has a value within the range of zero or 5 greater but not greater than 1.

28. The semiconductor optical device according to claim 17, wherein said current block semiconductor region comprises first and second current block layers;

wherein said first conductivity type semiconductor 10 region is made of an $Al_{x_1}Ga_{1-x_1}As$ semiconductor, where a composition X_1 has a value within the range of zero or greater but not greater than 1;

wherein said second conductivity type semiconductor layer is made of an $Al_{x_2}Ga_{1-x_2}As$ semiconductor, where a 15 composition X_2 has a value within the range of zero or greater but not greater than 1; and

wherein said first and second current block layers are made of $Al_{x_3}Ga_{1-x_3}As$ semiconductor, where a composition X_3 has a value within the range of zero or greater but not 20 greater than 1.

29. The semiconductor optical device according to claim 24,

wherein said first and second SCH layers is made of 25 one of $Al_xGa_{1-x}As$ semiconductor ($0 \leq X \leq 1$) and $Ga_xIn_{1-x}As_yP_{1-y}$ semiconductor (about $0.5 \leq X \leq 1$, $0 \leq Y \leq 1$), said $Ga_xIn_{1-x}As_yP_{1-y}$ semiconductor lattice-matched to GaAs

semiconductor.

30. The semiconductor optical device according to claim 17, wherein said current block semiconductor region comprises first and second current block layers; and

5 wherein said first and second current block semiconductor layers are made of material not containing aluminum as a III group element.

31. The semiconductor optical device according to claim 17, wherein said current block semiconductor region comprises first and second current block layers; and

10 wherein said first and second current block semiconductor layers are made of material not containing aluminum as a III group element

15 wherein said first conductivity type semiconductor region is made of material not containing aluminum as a III group element

wherein said second conductivity type semiconductor layer is made of material not containing aluminum as a III group element.

20 32. The semiconductor optical device according to claim 17, wherein said surface of GaAs semiconductor is provided by one of a GaAs semiconductor layer and a gallium arsenide substrate.

25 33. The semiconductor optical device according to claim 17, wherein said semiconductor optical device is constituted to provide at least one of a semiconductor laser

diode, a semiconductor optical amplifier, and an electro-absorption modulator.